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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

AD-A164 775

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REPORT DOCUMENTATION PAGE

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1. REPORT NUMBER	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle) THE GROUND SURVEILLANCE AND CONTROL ELEMENTS OF THE TACTICAL AIR CONTROL SYSTEM (TACS) WITH MODULAR CONTROL EQUIPMENT	5. TYPE OF REPORT & PERIOD COVERED MMAS THESIS (FINAL)
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) BOBBY W. SMART, MAJ, USAF	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U. S. ARMY COMMAND & GENERAL STAFF COLLEGE ATTN: ATZL-SWD-GD FORT LEAVENWORTH, KANSAS 66027	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS	12. REPORT DATE 7 JUNE 1985
	13. NUMBER OF PAGES 98
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)	15. SECURITY CLASS. (of this report) UNCLASSIFIED
	15a. DECLASSIFICATION DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED.

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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

TACS	CRP	GACC
MCE	FACP	
CRC	MPC	

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

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THE GROUND SURVEILLANCE AND CONTROL ELEMENTS OF THE TACTICAL AIR CONTROL SYSTEM (TACS) WITH MODULAR CONTROL EQUIPMENT

A thesis presented to the Faculty of the U. S. Army Command and General Staff College in partial fulfillment of the requirements for the degree

MASTER OF MILITARY ART AND SCIENCE

by

BOBBY W. SMART, MAJ, USAF
B. S. UNIVERSITY OF ALABAMA, 1972

FORT LEAVENWORTH, KANSAS
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THESIS APPROVAL PAGE

Name of Candidate: MAJOR BOBBY W. SMART

Title of Thesis: The Ground Surveillance and Control Elements of the Tactical Air Control System (TACS) with Modular Control Equipment

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Philip J. Brookes, Director, Graduate Degree Programs
Philip J. Brookes, Ph.D.

The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U. S. Army Command General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

ABSTRACT PAGE

THE GROUND SURVEILLANCE AND CONTROL ELEMENTS
OF THE TACTICAL AIR CONTROL SYSTEM (TACS)
WITH MODULAR CONTROL EQUIPMENT
by Major Bobby W. Smart, USAF, 93 pages.

The TACS provides the Tactical Air Forces (TAF) Commander the capability to direct and control tactical air assets. The system is highly flexible and may be employed in support of a unified command, Joint Task Force (JTF), as an augmentation resource or as an independent element. This thesis focused on the ground surveillance and control elements of the TACS. The elements of the ground TACS are: Control and Reporting Center (CRC), Control and Reporting Post (CRP), Message Processing Center (MPC), and Forward Air Control Post (FACP).

This study examined the capability of Modular Control Equipment (MCE), envisioned to replace the CRC, CRP, MPC, and FACP, to improve command and control provided by the TACS. The investigation revealed that the ground surveillance and control equipment in the TACS is deficient and no longer provides the deployment and employment capabilities required by the Tactical Air Forces (TAF) Commander. Modular Control Equipment would eliminate these deficiencies and improve command and control provided by the TACS. MCE satisfies all of the requirements specified in USAF ROC 8-75A (Improved Forward Air Control Post) and TAF Statement of Need 316-80 (Improved Surveillance and Control System). In addition, the Air Force is tasked to provide Close Air Support (CAS), Battlefield Air Interdiction (BAI), and Air Interdiction (AI) support to the Army Commander. Research and development efforts indicate that a Ground Attack Control Center (GACC) capability can be produced using MCE as the hardware baseline. This new GACC capability would enable the Air Force to control and execute ground attack missions on the AirLand Battlefield.

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CHAPTER 1

INTRODUCTION

"Readiness is our Profession." This statement, the motto of the Tactical Air Command (TAC), emphasizes the importance of preparedness for war. The changing nature of the battlefield environment and the impact of improved technology on modern warfare, however, make preparedness a challenging and often evasive goal.

The challenge of how to employ and control airpower had its beginning with World War I. During this period, the airplane added a new dimension to the battlefield. With this capability came speed, range, firepower, and flexibility. Yet, there were problems with how to effectively employ this capability. "In World War I, the idea of air superiority was to win and maintain complete control over the airspace through the destruction of the enemy's air force. Experience proved that this idea was impractical and seldom, if ever achievable."[1]

The period between 1920 and 1941 saw tremendous improvements in aircraft capabilities, radar, and communications techniques. "However, the United States was yet to develop a system to effectively command and control tactical aircraft in the demanding and dynamic changing tactical environment."[2] World War II found the U. S. unprepared in the area of air employment. The Tunisian Campaign and the battle at Kasserine Pass highlighted

this serious deficiency. The Allied forces were far superior; yet they were defeated by a numerically inferior German Air Force. The Allied forces had no command and control structure with centralized control of air assets. The Germans, on the other hand, centralized control of air assets and brought them to bear with effective and decisive results. The Allies learned from this mistake and started to develop doctrine based on the concept of centralized control.

The U. S. Army Air Forces faced another problem as airpower technology improved. The doctrine being developed had to keep pace with the threat and technology. As one Air Force general officer explains, "Doctrine too often lags behind our technological advance."[3] When this happens, there is the potential for emerging technology to influence the development of doctrine. This situation becomes dangerous when emerging technology, rather than the threat, becomes the primary focus for doctrine development. The potential for problems increases if weapon systems are procured based completely on emerging technology, rather than their capability to execute sound doctrine.

The importance of developing sound doctrine and of ensuring that doctrine is consistent with technological advances cannot be overstated. General Curtis E. LeMay had some observations about the importance of doctrine.

> At the heart of warfare lies doctrine. It represents the central beliefs for waging war in order to achieve victory. Doctrine is of the mind, a network of faith and knowledge reinforced by experience which lays the pattern for the utilization of men, equipment, and tactics. It is the building material for strategy. It is fundamental to sound judgment.[4]

If doctrine is at the heart of warfare, then our systems must be designed and capable of waging war and achieving victory; or more simply stated, capable of carrying out our doctrine.

One of the fundamental doctrinal issues of air employment is command and control of air resources.

> Commanders, at every level, are better equipped to make correct decisions and to implement those decisions when they have an effective command and control structure that is simple, secure, and based on unity of command. This structure must provide the mechanism to survey and assess the battlefield situation accurately and to conduct offensive and defensive air actions to achieve objectives. Effective command and control provides commanders with the status and capabilities of both friendly and enemy forces and allows a commander to direct an air effort knowledgeably and efficiently. The most effective means for directing and executing an air effort is centralized control and decentralized execution.[5]

The understanding and application of this doctrinal concept provided the beginning for the current Tactical Air Control System (TACS). By the end of World War II, a basic TACS structure had been developed, and radar was being used to control aircraft and provide early warning of enemy air attacks. This system, and its associated doctrine,

continued to evolve during the Korean and Vietnam wars and has changed over time to meet the operational requirement.

PURPOSE OF THESIS

The purpose of this thesis is to compare the capabilities of the present-day ground surveillance and control elements of the USAF Tactical Air Control System (TACS) with the Modular Control Equipment (MCE) envisioned to replace the current system.

BACKGROUND

> A USAF Tactical Air Control System is the organization, personnel, procedures, and equipment necessary to plan, direct and control tactical air operations and to coordinate air operations with other Services and Allied forces. It is composed of control agencies and communications-electronics facilities that provide the means for centralized control and decentralized execution of tactical air operations.[6]

The TACS provides the Tactical Air Forces (TAF) Commander with the capability to direct and control tactical air assets. The system is highly flexible and may be employed in support of a unified command, Joint Task Force (JTF), as an augmentation resource or as an independent element. This flexibility enables the TACS to be easily adapted to meet changing tactical situations and employed across the full spectrum of conflict.

Command and control within the TACS is accomplished by people working in accepted and proven military organizations, employing forces in tactical and operational environments -- using time-proven methods. The command part of the process is the function which works to set priorities and strategies, and where forces are allocated. Allocation means assigning available weapons systems to specific jobs. The control side of the process involves people working to match weapons to targets according to the priorities and allocations given to them by a command level.

This command and control process is guided by doctrine. Doctrine is defined as the "fundamental principles by which the military forces or elements thereof guide their actions in support of national objectives. It is authoritative but requires judgment in application."[7]

This thesis will be concerned with the operational and tactical aspects of doctrine and how they relate to the TACS.

> Operational doctrine applies the principles of basic doctrine to military actions by describing the proper use of aerospace forces in the context of distinct objectives, force capabilities, broad mission areas, and operational environment."[8]

Within this framework, advances in technology and modernization initiatives will have an impact on operational doctrine.

> "Tactical doctrine applies basic and operational doctrine to military actions by describing the proper use of specific weapons systems to accomplish detailed objectives."[9]

Tactical doctrine, like operational doctrine, is concerned with how forces are employed.

The command and control process requires the employment of the Tactical Air Forces (TAF) in a tactical and operational environment; therefore, the nature of the environment is significant. The environment is characterized by the opportunity for having combat theaters anywhere in the world. To meet this requirement, the TACS must be designed to respond to contingencies on a worldwide basis. Once deployed in a given theater, the environment dictates that air forces perform a number of related air missions in the same airspace at the same time. These missions may include Air Defense, Air Surveillance, Airspace Management, Air Interdiction (AI), Battlefield Air Interdiction (BAI), Counter Air (CA), Close Air Support (CAS), Reconnaissance, Airlift, Electronic Warfare and other diverse activities.[10]

To meet and counter an enemy attack, command and control must be capable of performing these diverse missions at any level of conflict. The system must be highly mobile and capable of deployment and employment in any theater of operation. It must be sophisticated enough to handle a high

threat, high density environment. The level of threat activity may vary in different scenarios; however, the diversity of the operation will be constant. The command and control structure must fit the scenario, and it must also fully exploit the potential of the system used to manage the complex and dynamic environment.

"Use of the Tactical Air Forces (TAF) requires effective use of all available command and control resources."[11] This means being able to see the situation developing and having the capability to present appropriate decisionmakers with understandable information. When this capability exists, the TACS becomes the focal point in bringing together the functional military forces into a unified fighting team. Decisionmakers are then able to posture forces correctly and employ forces accurately. The necessity for the commander to have one system to exercise centralized control over his forces is paramount. In addition, this capability is vital to the success of any military operation regardless of the level of conflict or type mission being conducted.

The structure to accomplish this task is established, understood, and exercised on a daily basis. However, the modern battlefield threat changes as technological advances occur and better systems are developed. A system that is considered state-of-the-art today may be technologically obsolete in a few short years. Clearly, there is a real

requirement to meet the challenge of expanding technology. To accomplish this, doctrine must be the point of reference used to keep employment concepts in line with design improvements.

The TACS is an inherent part of this dynamic command and control process. To keep pace in this environment, where advancing technology is changing the nature of warfare, requires force modernization. More survivable, reliable, and flexible equipment with increased mobility is essential, but the system procured must provide the capability to execute current doctrine. The Air Force must equip the TACS with technology that is capable of achieving objectives against current threats and that possesses the capability and growth potential to respond to projected threats.

HYPOTHESIS STATEMENT

The hypothesis of this thesis is that the Modular Control Equipment (MCE) envisioned to replace current TACS equipment will improve command and control provided by the TACS.

METHODOLOGY

Chapter II provides a review of literature. Four categories of research material were used: general reference literature, regulations and manuals, professional military studies, and contractor data. Each source category provided command and control related information for a comparative analysis of the current and proposed system. Comments are made on the usefulness and validity of each document.

Chapter III examines the current tactical command and control environment. This includes a discussion of the relationship and mission of the various ground surveillance and control elements of the TACS. This chapter also examines the current system's deficiencies.

Chapter IV lists and discusses the characteristics and capabilities of the Modular Control Equipment (MCE). MCE is being considered by the Air Force to replace the current ground TACS equipment. Today's system and equipment are concerned with the air threat; however, the Air Force is tasked to provide Close Air Support (CAS), Battlefield Air Interdiction (BAI), and Air Interdiction (AI) support to the Army Commander. The Air Force is limited in executing this tasking. Limitations center on the inability to detect ground targets and to control and execute ground attack missions. To correct this limitation, MCE could be used as

the hardware baseline to develop a Ground Attack Control Center (GACC) capability. Having examined MCE, the last section is devoted to validating the thesis hypothesis. A comparative analysis of capabilities is conducted to determine the similarities and differences between the current ground TACS equipment and MCE. A hypothetical TACS contingency operation provides the basis for the comparison. This comparison leads to conclusions concerning MCE's capability to improve command and control provided by the TACS.

Chapter V examines the force integration of MCE into the TACS structure. This disucussion looks at some of the problems associated with introducing a completely new family of equipment into the existing TACS structure. Deployment and employment strategy for MCE is examined within the framework of current Air Force doctrine. Doctrinal and force structure issues are addressed as part of MCE force integration. Finally, there is a section on recommendations for future study to make the TACS a viable system between 1990-2000.

ASSUMPTIONS

Six assumptions are essential in an analysis of the Air Force Tactical Air Control System.

(1) There is a requirement for an improved ground command and control system capable of operating in a more complex and demanding tactical environment.

(2) The requirement for an improved operational capability for the command and control system is brought about by improved technology, improvements in the weapons systems of potential adversaries, and current system deficiencies.

(3) Based on current operational deficiencies, equipment obsolescence, and the 1990 postulated threat, there is a requirement to upgrade the Forward Air Control Post (FACP), Control and Reporting Post (CRP), Control and Reporting Center (CRC), and Message Processing Center (MPC).

(4) The Modular Control Equipment (MCE) program is the candidate to replace the FACP, CRP, CRC, and MPC, and it could be phased into the USAF inventory in mid-1988.

(5) AirLand Battle doctrine will require the TACS to develop a capability to control attacks against time-sensitive ground targets.

(6) The Ground Attack Control Center (GACC) capability, which has Modular Control Equipment as the hardware baseline, is a candidate for providing this ground attack control capability.

DEFINITION OF TERMS

The ground surveillance and control elements of the TACS will be discussed later. The following definitions offer a brief explanation of the element's function.

(1) Tactical Air Control Center (TACC). The TACC is the senior air operations element of the TACS. It functions as the Air Component Commander's operation center/command post, providing the facility and personnel necessary to accomplish the planning, directing, and coordinating of tactical air operations.[12]

(2) Message Processing Center (MPC). The primary element responsible for assuring the automatic transfer of tactical data over digital data links (TADIL A and TADIL B) between elements of the ground TACS, the E-3A Airborne Warning and Control System (AWACS), Joint, and Allied command and control systems.

(3) Control and Reporting Center (CRC). The CRC is directly subordinate to the TACC and is the primary radar element concerned with decentralized execution of air defense and airspace control functions.[13]

(4) Control and Reporting Post (CRP). The CRP is subordinate to the CRC. A CRP has capabilities similar to a CRC and may assume CRC functions when required.

(5) Forward Air Control Post (FACP). The FACP is a mobile radar element that is subordinate to the CRC. It is

normally deployed into forward areas to extend radar coverage and to provide control of air operations, early warning surveillance, and gap filler service.[14]

(6) Airborne Warning and Control System (E-3A/AWACS). The AWACS is an airborne radar control element of the TACS. It has the ability to provide detection and control of aircraft below or beyond the coverage of ground-based radar, or when ground-based radar elements are not available.[15]

(7) Ground Attack Control Center (GACC). The GACC is directly subordinate to the TACC and is the primary element concerned with the decentralized execution of attacks against selected time-sensitive ground interdiction targets.[16] The GACC is still in the initial operational concept phase and is not currently a fielded capability.

(8) Modular Control Equipment (MCE). The MCE is a transportable, modularized system which is in development and expected to be fielded in the late 1980's. This new system would replace the Message Processing Center, Control and Reporting Center, Control and Reporting Post, and Forward Air Control Post.[17]

LIMITATIONS

The thesis is constrained in the following ways:

(1) Tactical Air Control System (TACS) ground surveillance and control elements not envisioned to be replaced by Modular Control Equipment (MCE) will not be considered. Specifically, the study will not address the Tactical Air Control Center, the Wing Operations Center, Airlift Control Center, Air Support Operations Center, and E-3A Airborne Warning and Control System (AWACS).

(2) The Modular Control Equipment (MCE) designed to replace the current TACS elements is still in the development phase. The system is not expected to be fielded and fully operational until mid-1988. Therefore, characteris- tics and capabilities are limited to contractor information.

ENDNOTES

1. Air Superiority in World War II and Korea (1983): 8.

2. The Tactical Command and Control Environment (12 September 1984): 11.

3. U. S. Army Command and General Staff College, P612, War and Doctrine (Academic Year 1984-85): 105.

4. U. S. Air Force, AFM 1-1, Basic Aerospace Doctrine of the United States Air Force (1984): Introductory Comment.

5. Ibid., p 2-20.

6. U. S. Air Force, TACR 55-45, Tactical Air Force Headquarters and Tactical Air Control Center -- Operations (1984): 5-1.

7. U. S. Air Force, AFM 1-1, Basic Aerospace Doctrine of the United States Air Force (1984): v.

8. Ibid., p vi.

9. Ibid., p vi.

10. TAC Manual 2-1, Tactical Air Operations (1978): 1-5.

11. U. S. Army, FC 100-26, Air-Ground Operations (1984): 1-1.

12. U. S. Air Force, TACR 55-45, Tactical Air Force Headquarters and Tactical Air Control Center -- Operations (1984): 5-1.

13. Ibid., p 5-1.

14. Ibid., p 5-3.

15. Ibid., p 5-3.

16. Ibid., p 5-3.

17. Modular Control Equipment, Litton Data Systems: p 1.

CHAPTER II

REVIEW OF RESEARCH LITERATURE

This chapter reviews the research literature used to develop the thesis. Four categories of research material were used: general reference literature, regulations and manuals, professional military studies, and contractor data.

The modern Tactical Air Control System (TACS) had its beginning in World War II. There were other rudimentary efforts to develop a command and control structure prior to this period. The British, Russians, and Germans experimented with a command and control structure; however, the discovery and wide employment of radar during the 1930's influenced the TACS and helped to accelerate the process. Therefore, most of the literature used to develop this thesis will be from the 1930 period to the present.

RESEARCH STUDY

To understand the evolution of air employment and its relationship to command and control required a thorough review of general reference literature dealing with Air Force ideas, concepts, and doctrine. This historical perspective was then applied to current Air Force regulations and manuals. The guidance and direction found in these publications explained how the TACS functions

today. With this foundation, research turned to professional military studies that addressed the TACS. The last source of literature was contractor information. This data explained the capabilities and limitations of the Modular Control Equipment. This system would replace the current TACS equipment, and the information was invaluable when analyzing future capabilities and characteristics.

GENERAL REFERENCE LITERATURE

One of the most informative books on the subject of command control was Command and Control and Communications Structures in Southeast Asia by Lieutenant Colonel John J. Lane, Jr. The book traced the evolution of command and control and communications (C^3) processes which support air combat operations. The book specifically addressed the C^3 process as it applied to the Vietnam war; however, there were implications and insights for the application of command and control in any theater of operation. Air Superiority in World War II and Korea was a book published by the Office of Air Force History in support of Project Warrior. This publication was an interview with General James Ferguson, General Robert M. Lee, General William Momyer, and Lieutenant General Elwood R. Quesada. This candid exchange of ideas provided valuable information on the tactical principles of war and the application of

airpower. These books provided a historical perspective of tactical air operations through the Korean War period. The book Limited War Revisited by Robert E. Osgood examined the strategy of limited war from the Korean period to the present time. It discussed the U. S. doctrine of flexible and controlled response and how it related to military capability. This book had utility when considering the Tactical Air Control System mission of supporting limited wars.

REGULATIONS AND MANUALS

Military publications, specifically regulations and manuals were a valuable source of information. An understanding of the TACS structure, guidance, and procedures was necessary, and these publications provide that information. Air Force Manual 1-1, Basic Aerospace Doctrine of the United States Air Force, explains Air Force doctrine for preparing and employing forces and was the point of depar- ture for all analysis. Air Force Manual 2-7, Tactical Air Force Operations - Tactical Air Control System (TACS), provides the operational doctrine for directing, coordinating, and controlling the Tactical Air Forces and employing the TACS structure in support of tactical air operations. The manual is an excellent source document for explaining the principles of tactical air

operations and how they relate to the TACS. TAC Manual 2-1, Tactical Air Operations, explains the missions, functions, and activities of the Tactical Air Command and how they interrelate in tactical air operations. This manual is helpful in relating the TACS mission to the total tactical air theater of operation. A draft manual is currently in the review process and will replace the 1978 manual. Both manuals were used for this thesis. TAC Pamphlet 55-43, Tactical Air Control System Equipment, provides a reference for the basic characteristics of the major TACS equipment. This pamphlet includes a description, capabilities, and technical order specifications for all major TACS equipment items. It is an valuable source of data when making specific comparisons between current and proposed items of equipment. TAC Regulation 55-44, Tactical Air Control System (TACS), Surveillance and Control of Tactical Air Operations, provides the procedural guidance for the operation of the TACS surveillance and control elements. This document was published in 1975 and is in serious need of revision. Many of the procedural aspects of the regulation are dated; therefore, it was of almost no value when developing this thesis. TAC Regulation 55-45, Tactical Air Force Headquarters and the Tactical Air Control Center (TACC), provides information on the command functions which work to set priorities, develop strategies, and allocate resources. An understanding of the centralized command

function was necessary before the decentralized control level could be examined. TAC Regulation 50-32, Tactical Air Control System - E-3A/Ground Environment Interface Training is helpful in understanding the technical and tactical interface between the ground and airborne elements of the TACS.

Several U. S. Army Field Manuals were used to ensure consideration was given to AirLand Battle doctrine. The primary source document was FM 100-5, Operations. It describes the U. S. Army operational doctrine and is a good reference when examining the Ground Attack Control Center (GACC) concept. FC 100-1-103, Army Airspace Command and Control in a Combat Zone explains how the Army command control system functions in its assigned sector. FC 100-26, Air-Ground Operations is helpful in explaining the joint air-ground operations system.

PROFESSIONAL MILITARY STUDIES

Only one unclassified research study relating to this thesis was of interest. The study, The Tactical Air Control System: 1985 and Beyond, by Lieutenant Colonel Thomas L. Waldrop was written in 1977 and presented at the 1978 Airpower Symposium. This paper provides some information on the status of the TACS structure in the mid-1970's. The 407L and 485L systems and equipment were starting to

experience problems, and there was already a requirement for a replacement TACS. The author does a good job conceptualizing what the TACS of 1985 and beyond should look like in terms of characteristics and capabilities. This was valuable because it provided the starting point for this thesis.

There have been several efforts which addressed the need to modernize the TACS. They include USAF ROC 8-75A, which was an operational requirement statement submitted in 1976 to replace the Forward Air Control Post. A Tactical Air Command Zero Based Review of the TACS was initiated in 1978, and this study provides force structure data and deficiency reports on TACS facilities during this period. The Statement of Need (SON) for an improved surveillance and control system to replace the CRC and MPC plus the SON for the GACC provides data on capabilities and characteristics for a replacement TACS structure.

Only a limited number of periodicals were available on the TACS. One technically oriented periodical, Signal, has some relevant information on the subject; however, not much has been published in non-military or military periodicals on the Tactical Air Control System.

CONTRACTOR INFORMATION

The Modular Control Equipment (MCE) discussed in this thesis is still in the full scale development phase. A production go-ahead is currently scheduled for mid-1985. Information concerning the characteristics of the system was obtained from Litton Data Systems. Interviews with Litton representatives were also used to gather data. Mr. James W. Emory, Manager for Tactical Requirements, Litton Data Systems, provided MCE specification data and valuable information on the overall MCE program. In addition to the contractor derived data, information was received from the Program Element Monitor and Research and Development Officer at HQ USAF.

SUMMARY

This review of literature is a summary of the information used to develop the thesis. The scope includes a historical review of U. S. Air Force tactical air operations in three wars. This was complemented by a review of military strategy and doctrine to gain an overall appreciation for the command and control process. The review then focused on current system capabilities, guidance, and procedures found in military regulations and manuals. Finally, contractor literature and interviews provided an insight into the TACS structure of the future.

CHAPTER III

THE CURRENT GROUND SURVEILLANCE AND CONTROL STRUCTURE

The purpose of this chapter is to examine the current ground surveillance and control elements of the Tactical Air Control System (TACS). This examination addresses the following elements: Control and Reporting Center (CRC), Control and Reporting Post (CRP), Message Processing Center (MPC), and Forward Air Control Post (FACP). The examination will include a look at the tactical command and control structure and how it has evolved. After this examination, there will be an analysis of the characteristics, capabilities and deficiencies of the elements that comprise the present-day TACS.

HISTORICAL PERSPECTIVE

The TACS employment doctrine has evolved over time to meet changing operational requirements. The organizational structure, however, has remained basically the same as that employed by U. S. Army Air Forces in World War II (Europe) and Korea. U. S. Army Air Forces learned many lessons about employment of tactical airpower in North Africa. When the Allies invaded Europe in 1944, American tactical airpower was centrally coordinated and controlled through various levels of command, control, and reporting stations. The

TACS remains today essentially a structure with a command level allocating and tasking resources and a control level executing missions by directing weapons to targets.

The diverse mission of the TACS has demanded a highly mobile and flexible system. "A TACS is an integral and inseparable part of the combat force management and is composed of elements that, by virtue of their mobility and flexibility, permit tailoring to a large or small-scale operation in varying intensities of warfare."[1] To accomplish this mission, the individual elements must be manned and equipped to permit tailoring to meet the requirements of the tactical situation.

The mobility requirement and force-sizing aspect of the TACS dictates that it be capable of deployment to any area of the world in support of national policy. Changes in national policy, and the corresponding change in U. S. military strategy, have influenced the equipment mix, operational capability, and doctrine of the system. After World War II, with containment as the basic national policy, the principle areas of military concern were Europe and Korea.[2] The TACS had proven itself capable of supporting a World War II type war in Europe. After the war, there was no requirement for a more capable or different system. Therefore, the TACS structure and equipment used during World War II were carried over and used during the Korean War.

The limited war strategy of the 1960's resulted in a change in focus for the TACS. This period in the TACS's history saw an increase in overseas deployments in response to Communist expansion in Southeast Asia. For the first time since Korea, the TACS was tasked to support national policy in response to a real-world overseas contingency. It was during this period that equipment deficiencies started to impact on the operational effectiveness of the system. "The critical shortage and out-of-date capabilities of the TACS were noted by the Office of Secretary of Defense (OSD) in November 1963, and OSD authorized an emergency procurement program to modernize the TACS."[3] The program stressed the procurement of equipment deployable throughout a range of graduated conventional responses, where mobility was essential.

The modernization initiative was extensive, and a special project office was established to manage the equipment replacement effort. The overall program was called the 407L program. It was implemented through a series of procurements. The first phase occurred from 1965-1968 and included the purchase of off-the-shelf technology to provide a Forward Air Control Post (FACP) capability. Phase II, 1968-1972, emphasized a mobile and semi-automated system to replace the manual equipment of Korean War and earlier vintage. The present CRC and CRP facilities and equipment were fielded during this time. A

third phase, termed 485L, was scheduled for the 1973-1980 period. This phase was intended to continue automation of the TACS, with particular emphasis on automating the command level functions. This phase encountered problems with requirements definitions and later funding shortfalls. As a result, only the Message Processing Center (MPC) and a radar remoting device (AN/GSQ-120) were fielded during this period.

The third phase of the TACS upgrade program was an especially critical period in the TACS's evolutionary development. During this time, there was considerable debate in the Tactical Air Force (TAF) concerning the doctrinal application of the TACS. The TAF was unable to decide what capabilities were needed and how the system would be doctrinally employed. Suddenly, technology was progressing at a rapid pace, and the tendency was to pursue a moving technological baseline.

> The desire to look across the horizon on some new product that was superior to the one being developed, led to a loss of critical general officers' support and ultimately the funds identified for the original equipment. As a result of this fragmented TAF position, that was, by and large, created at the action officer level, no significant improved operational capability has been fielded in the TACS since the MPC in 1976.[4]

CONTROL AND REPORTING CENTER (CRC)

The tactical air command and control structure is established on the same principle, which expresses how forces operate -- centralized control and decentralized execution. This means that certain functions are centralized at the command level: taskings are coordinated, priorities are established and resources are allocated. However, the matching and directing of weapons to targets and assuring that forces move through the system in an efficient way are decentralized to the control level for execution. This study will be limited to decentralized execution at the control level.

The Control and Reporting Center (CRC) is the top level in the control structure. The CRC reports directly to the Tactical Air Control Center (TACC), the command level from which it gets tasks and allocations of weapons.

> CRC's are the senior radar elements in the TACS structure and are responsible for decentralized execution of air defense and airspace control. Within its area of responsibility, a CRC provides air defense and aircraft control or monitoring for both offensive and defensive missions. During air defense operations, the CRC detects and identifies hostile airborne objects, designates air defense warning conditions, directs weapons systems, and scrambles or diverts, with TACC concurrence, air defense capable aircraft. During joint operations, a CRC is responsible for assigning hostile airborne targets to the Army air defense system.[5]

The nomenclature designation for the CRC Operation Center is the AN/TSQ-91. As discussed previously, the mobility requirement of the CRC demands that it be flexible and capable of being tailored to the level of conflict. There is no classical CRC configuration, because the CRC has no definite size or shape.

> Modular in design, the CRC is capable of adjusting to the needs of a given deployment by additions/deletions to the basic set of the following modules: Group Display Module (GDM), Console Module (CM), Data Processing Module (DPM), Ancillary Equipment Module (AEM), and Air Conditioning Module (ACM).[6]

The Console Module (6,206 lbs) and the Group Display Module (6,500 lbs) are joined together by an inflatable shelter to form an operations room. One Console Module contains four operator console display positions. The Group Display Module contains power and communciations equipment. The Data Processing Module (5,450 lbs) is the hub of the automation capability. It contains a computer with 131,000 words of core storage capacity plus peripheral devices. The Ancillary Equipment Module (5,240 lbs) contains the display buffer, data distribution group, automatic data link (ADL) modems and two operator console display positions. The Air Conditioning Module (5,775 lbs) provides cooling for all associated equipment. These five modules (approximately 29,000 lbs) when connected form a minimum CRC configuration.[7] "Additional Console, Group Display, and Air

Conditioning Modules are added to conform to the three basic configurations: minimum, intermediate, and maximum."[8] The number of modules required for each configuration is listed in Table 1.

In addition to the five basic modules that comprise the AN/TSQ-91, other communications and support equipment are required to give the CRC an operational capability. Table 2 lists the additional equipment for a CRC maximum configuration.

There are four planning factors which must be taken into consideration when deploying a CRC. These factors are: configuration, erection time, personnel requirements, and airlift. With a maximum configuration, the erection time would be eighteen to twenty-four hours. This configuration would require approximately 266 people for operations and maintenance support. In addition, the entire maximum configuration would require forty-nine C-141's for airlift. The minimum CRC configuration would require 109 people and could be erected in approximately six hours. The airlift requirement would be thirteen C-141's.[9]

The present CRC equipment was conceived in the early 1960's and fielded in the early 1970's. There has been no major modernization in the last fifteen years, and the semi-automated equipment is fast reaching obsolescence. In addition, the equipment is becoming increasingly difficult to support. Although there has been no major modernization,

MODULE	MINIMUM	INTERMEDIATE	MAXIMUM
Console	1	2	3
Group Display	1	2	3
A/C	1	2	2
Ancillary Equipment	1	1	1
Data Processing	1	1	1

NUMBER OF MODULES FOR EACH CONFIGURATION

TABLE 1

NOMENCLATURE	COMPONENT NAME	NUMBER
AN/TPS-43E	RADAR SET GROUP	1
AN/TSC-60	COMMUNICATIONS CENTRAL (HF/SSB RADIO)	3
AN/TSC-62	COMMUNICATIONS CENTRAL (CIRCUIT PATCH/SWITCHBOARD)	1
AN/TRC-87	RADIO SET (UHF GROUND/AIR RADIO)	3 (15 CHANNELS)
AN/TRC-97	RADIO SET (TROPOSCATTER RADIO SET)	10
AN/TTC-30	TELEPHONE CENTRAL OFFICE	1
AN/TGC-28	TELETYPE COMMUNICATIONS CENTER	1

CRC COMMUNICATION AND SUPPORT EQUIPMENT

TABLE 2

there have been numerous efforts which addressed the need to modernize. Table 3 is a chronological listing of the key efforts.[10] The deficiencies identified in these documents were translated and published in May 1979 in the Tactical Air Force TACS Command Control and Communications Mission Area Analysis Study. The deficiencies and their impact can best be described and scoped under three main headings: mobility, survivability, and operational capability. A brief explanation of each deficiency will provide some insight into the magnitude of the overall problem.

The CRC equipment mobility is greatly restricted by the extensive deployment/setup time. A TSQ-91 could take up to twenty-four hours to set up and requires forty-three people for erection. The equipment is heavy and bulky. It requires excessive handling, and the inflatable shelters are susceptible to rips, punctures, and environmental damage. When prepared for deployment, road convoys are lengthy, and a maximum CRC requires a prohibitive amount of airlift.

The CRC survivability is dubious in combat because of the size of the facilities and the infrared (IR) signature most elements produce. The power required to keep the inflatable shelters erect, combined with the power consumption of the support equipment, becomes prohibitive for sustained operations. In addition, the communications suffer interference, are not jam resistant or secure, and are slow in distributing information.

•USAF ROC 8-75A (IMPROVED FORWARD AIR CONTROL POST)	1976
•NATO TASK FORCE FIVE REPORT	1977
•TAFIIS MASTER PLAN VOL VI	1978/79
•NATO RATIONALIZATION, STANDARDIZATION and INTEROPERABILITY MASTER PLAN	1978
•TACS FUNCTIONAL MANAGEMENT INSPECTION	1978
•TAC ZERO BASED REVIEW OF TACS	1978
•DR HERMANN REPORT	1979
•TAF CONOPS FOR AIR SURVEILLANCE and CONTROL ELEMENTS OF THE TACS	1979
•TACS C3 MISSION AREA ANALYSIS	1980
•TAF SON 316-80 (IMPROVED SURVEILLANCE and CONTROL SYSTEM)	1982
•GROUND ATTACK CONTROL CENTER (GACC) STATEMENT OF NEED	1982

MODERNIZATION EFFORTS

TABLE 3

The last deficiency centers on the computer system growth potential. "The current 407L systems use the Hughes 4118 computer, developed, and produced using 1960's technology. This computer long ago reached its capacity."[11] Solving this problem would require replacement of processors and input devices, or removing lower priority but necessary operational requirements.

CONTROL AND REPORTING POST (CRP)

The element in the tactical air command and control structure that reports dirctly to the CRC is the Control and Reporting Post (CRP).

> CRP's are subordinate to the CRC and provide radar surveillance and control within assigned areas of responsibility. CRP's have capabilities similar to the CRC and may assume CRC functions when required. One or more CRP's may be used depending on area size, terrain features, and the anticipated level of air operations.[12]

The CRP has the same equipment and number of personnel as a CRC. The primary difference is one of employment considerations. The CRP is located forward of the CRC, closer to the battle area that is to be defended. When deployed, the CRC and CRP will normally strive to become operational at the same time. The CRP performs surveillance and control within an assigned subsector. CRP's have the capability of assuming CRC functions in an

emergency. With the same capability and built-in commonality of equipment, the CRP adds a dimension that increases the overall flexibility of the TACS. The functions of the CRP are similar to those assigned the CRC, except that the CRP will not normally be assigned an identification function. The deficiencies associated with the CRP are the same as those with the CRC.

FORWARD AIR CONTROL POST (FACP)

The Forward Air Control Post (FACP) is a small radar, communications, and control facility. It is equipped with a surveillance and control radar, point-to-point and ground-to-air communications and a small operations facility. The FACP will normally be deployed in the initial move of an assault operation to provide a minimal aircraft control and warning capability pending the deployment of CRC's and CRP's. Subsequently, the FACP will be deployed into the forward area of the battle zone to provide increased low-level radar coverage of air operations. FACP elements will also provide early warning and gap filler service to the TACS.

The FACP is significantly different from the CRC and CRP in that it is a totally manual radar facility. The nomenclature designation for the FACP operations facility is AN/TSQ-61.

> FACP's are subordinate to the CRP. FACP's are normally deployed into forward areas to extend radar coverage. FACP's are very mobile and can be moved quickly to maintain desirable locations in changing tactical situations.[13]

The FACP has only two operator positions, and all surveillance information must be voice communicated to a CRP. Two additional operator positions are available in the AN/TPS-43E radar set, giving the FACP a total of four operator positions. The ground/air communications capability is provided through the AN/TSC-53 Communications Central. A total of six radios are available in this facility: two AN/ARC-51 BX UHF transceivers, two R/T-80A VHF transceivers, one AN/GRC-106 HF transceiver, and one AN/GRC-157 transceiver. Both the AN/ARC-51 BX and the R/T-807A provide simplex, amplitude modulated (AM) communications. The AN/GRC-106 provides simplex, upper sideband (USB), amplitude modulated (AM), or continuous-wave (CW) communications.[14] The AN/TRC-97A Radio Set would also be deployed for voice and teletype connectivity with the TACS structure.

The FACP is a relatively small unit; however, the airlift required to move the equipment is high when compared to the overall capability achieved.

> Full manning for the FACP is 59 people. It is capable of mobilization in twelve hours, and requires eleven C-141's for airlift. The minimum package consists of 33 people and needs five C-141's for movement.[15]

The primary deficiency of the FACP is lack of automation. All TACS units except the FACP share surveillance and control information via a data link network. This computer-to-computer interface provides a synergistic effect and thus a more complete composite air picture. The FACP must interface over a voice circuit which is time consuming, less reliable, and susceptible to communications problems.

The CRC, CRP, and FACP all employ the same search radar, the AN/TPS-43E. The TPS-43E is a three dimensional, highly mobile radar with a range in excess of 200 NM. It is designed for simultaneous long range search and height finding in severe weather and/or a jamming environment. The complete radar set is housed in one shelter plus the antenna pallet. The TPS-43E utilizes a stacked beam antenna configuration as a means of providing range, height, and azimuth information.

MESSAGE PROCESSING CENTER (MPC)

In February 1969, the Joint Chiefs of Staff (JCS) directed the Chiefs of the Services to establish a program to insure that their respective tactical command and control systems could exchange digital data on a real-time or near-real time basis. The Chief of Staff of the Air Force delegated this function to the Directorate of Production and

Programming. This Air Staff office of primary responsibility assigned lead responsibility to the Air Force Systems Command (AFSC). AFSC designated the 485L program office of their Electronic Systems Division (ESD) as the focal point for designing hardware and software modifications.

The Tactical Air Control Systems/Tactical Air Defense Systems (TACS/TADS) interface satisfied this JCS directive and provided the Air Force TACS with an improved capability to interface via digital data links internally to the TACS and externally with the U. S. Army AN/TSQ-73 Air Defense Command and Control System (AADCCS), the U. S. Navy and Airborne Tactical Data Systems (NTDS/ATDS), and the U. S. Marine Corps Air Command and Control Systems (MACCS).

Within the TACS, the computer software programs of the CRC and CRP were changed to incorporate the TACS/TADS required changes. However, the most significant aspect of the program was the development of a Message Processing Center (MPC). Up until this time, the CRC and CRP werelimited to TADIL B communications. TADIL B was a full duplex data link used to exchange data between two units. TADIL B normally used a line-of-sight troposcatter radio set as the exchange path. This worked fine between two ground based sites such as a CRC or CRP; however, it was not feasible between constantly moving sites, such as ships or aircraft. Consequently, another method of exchange which

was not limited to line-of-sight, point-to-point communications was required. This requirement was satisfied through the use of a high-frequency (HF) radio exchange path. This exchange of data over HF is referred to as TADIL A and the MPC was designed to provide this capability.

The 407L CRC and CRP did not have a TADIL A capability until the MPC was fielded in 1976. With the MPC, the TACS, for the first time, could communicate directly with the two Navy systems (NTDS and ATDS) and also the U. S. Marine Corps TADIL A elements. Additionally, the ground TACS could not interface and exchange surveillance and control information with the USAF E-3A Airborne Warning and Control System (AWACS) until the MPC was developed. This MPC capability greatly enhanced the Air Force compatibility and interoperability with sister Air Force TACS elements and joint service air defense systems.

The MPC has no organic radar but receives surveillance and control information from other TACS/TADS units via TADIL A and TADIL B. Therefore, the MPC is the primary element responsible for assuring the automatic transfer of tactical data over digital data links between elements of the ground TACS, AWACS, and other service TACS/TADS command and control systems. The MPC may be utilized through the full spectrum from a data link interface to battle management command and control.

The MPC is designed to allow management of data received from interfacing units. This management can be technical management, such as monitoring of data links, insertion of data filters, and conflict resolution. It may also be tactical management, such as initiation of weapons engagement orders and resolutions of conflicts. Technical management must be accomplished to continue operation of the digital interface while tactical management is accomplished only with the authorization of the Area Air Defense Commander/Airspace Control Authority.

The MPC is designed to provide centralized management of area tactical air operations and as such would probably be employed during the initial deployment to provide the TAF commander with time critical information needed for battle management decisions.

> The mode of deployment and responsibilities of the MPC shall be flexible so as to support all the TAF commander's deployment requirements. In addition to the data link management function, the MPC may be assigned responsibility by the TAF commander for: (1) defensive counterair operations; (2) management and resolution of conflicts of the real-time tactical data being exchanged over the digital data links; (3) preparation and dissemination of the necessary technical and tactical prearranged data items necessary for operating in an automatic tactical environment.[16]

The MPC is designed with special hardware and software capabilities. The MPC employs a standard CRC computer, ten TADIL B and one TADIL A terminals, organic

voice communications equipment and up to six display consoles. The MPC is formed from three basic and two additional modules. The Data Processing Module (DPM), Ancillary Equipment Module (AEM), and the Air Conditioning Module (ACM) form the basic MPC. The nomenclature designator is AN/TYC-10 for this three module configuration. When configured for six display consoles, the MPC requires two additional modules, the Console Module (CM) and the Group Display Module (GDM), which together form a one-cell MPC configuration. In addition to the basic modules, two AN/TSC-60 Communications Central vans are required for high frequency, single sideband (HF/SSB) communications. If ultra high frequency (UHF) communications is required for an operation, one AN/TRC-87 Radio Set will have to be deployed.

The MPC (AN/TYC-10) hardware differs from the CRC hardware in one way. The Data Processing Module was modified to include a USQ-59 data terminal set for TADIL A operations. The other difference is the software. The MPC software employs the Interface Message and Processing Program (IMPP) to perform the message translation, display, and message generation functions. The IMPP provides the basic capacity to receive, store, display, filter, and transmit tracks, fixed points, and jamming strobes within an area greater than 1,000 miles centered on its location.

The MPC is the only system in the Air Force TACS which is capable of providing intra- and inter-service

TACS/TADS elements with a real-time air picture. Because of this flexibility, the MPC can operate in a number of configurations, depending on the number of interfacing units and the scale of the tactical operation. Full manning for the MPC is twenty-five people. The MPC may be employed as follows: MPC stand alone (2 console), MPC with a single cell (six consoles), MPC collocated with TACC (two or six cells), and MPC collocated with a CRC (two or six cells). There are only eight MPC's worldwide. This limits the ability of the TACS to attain system interoperability with other U. S. Services and Allied systems.

Although the MPC was fielded in 1976, it still employs basically the same hardware as the CRC. Therefore, the MPC suffers the same inherent deficiencies as the CRC and CRP. Yet, a more serious operational problem plagued the MPC from its initial employment. An operational concept for employment of the MPC was never fully developed; therefore, the capability of the system was never fully realized or utilized. This observation is hard to document, since no baseline for measuring the system's capability was ever established. However, it is fair to say that the MPC, as employed today, provides primarily a technical capability with no tactical application. The MPC was not designed with this intent; therefore, weak procedures, not technology, are the primary cause of the unexploited capability.

SUMMARY

The TACS employment doctrine has evolved over time to meet changing operational requirements. The TACS structure and equipment used during World War II were essentially unchanged until the TACS was called on to support overseas deployments in Southeast Asia. During this period equipment deficiencies started to impact on operational readiness. In response to this problem the OSD authorized an emergency procurement program in 1963 to modernize the TACS. When the modernization effort was complete, the Forward Air Control Post and Control and Reporting Center had been upgraded, and the Message Processing Center had been developed. However, there has been no modernization in recent years and the equipment is fast reaching obsolescence.

ENDNOTES

1. U. S. Air Force, AFM 2-7, Tactical Air Force Operations Tactical Air Control Systems (TACS): 2-2.

2. Limited War Revisited (1979): 4.

3. Interview and telephone conversation with HQ USAF action officers, January/February 1985.

4. Interview and telephone conversation with Litton Data Systems personnel, February 1985.

5. U. S. Air Force, TAC Manual 2-1, Tactical Air Operations (1978): 3-12.

6. U. S. Air Force, TAC Pamphlet 55-43, Tactical Air Control System Equipment (1981): 4-16.

7. Ibid., p. 4-20.

8. Ibid., p. 4-16.

9. The Tactical Air Control System: 1985 and Beyond (1977): p. 39.

10. Proceeding of Presentations, Tactical Air Surveillance and Control Conference/Workshop, 10-12 June 1980, Volume 2(U) Rome Air Development Center, Griffiss AFB, New York.

11. Interview and telephone conversation with HQ TAC Computer Services Squadron (ADYU) personnel, February 1985.

12. U. S. Air Force, TAC Manual 2-1, Tactical Air Operations (1978): 3-12.

13. Ibid., p. 3-13.

14. U. S. Air Force, TAC Pamphlet 55-43, Tactical Air Control System Equipment (1981): 2-28.

15. The Tactical Air Control Systems: 1985 and Beyond (1977): 41.

16. U. S. Air Force, TAC Manual 2-1, Tactical Air Operations (1978): 3-12.

CHAPTER IV

THE MODULAR CONTROL EQUIPMENT (MCE)

The purpose of this chapter is to examine the major characteristics and capabilities of the Modular Control Equipment (MCE). In addition, the chapter will include a study of the Ground Attack Control Center (GACC), which would use MCE equipment as the hardware baseline. MCE is being considered by the Air Force as replacement system for the current USAF ground TACS equipment. The chapter is oriented toward an examination of MCE capabilities and a comparison of the present system and MCE.

HISTORICAL REVIEW OF TACS MODERNIZATION

In October 1979, the Tactical Air Forces (TAF) agreed to a basic preferred solution to TACS modernization. This preferred solution involved a building block approach to support U. S. contingency requirements. It was agreed that the system should have the technology to be interoperable with evolving command and control systems within NATO and Korea and meet the postulated threat through the mid-1990's. The preferred solution for modernization involved the development of a series of standardized vans, each designed to meet specific functions.

The conceptual design called for four vans to provide the desired capability. A radar/communications van would be a modified AN/TPS-43E radar van with a radar processor added. This would provide a minimally attended radar capability and permit the automatic transfer of radar plots to an adjacent or rear control facility. The second van would include a standard processor, operator display consoles, TADIL A, and bussed communications. This van would provide limited control and exchange of track information with the USAF E-3A AWACS and other service systems. Vans one and two would equate to a mini-FACP. The third van would provide more operator consoles to expand the FACP capability up to and including a full CRC capability. Finally, a fourth van would provide the fully automated interface management and area and regional air defense and airspace control capabilities to the TAF Commander. Based on the operational requirement, these basic vans could be brought together in various combinations to satisfy the command and control support desired.

Two approaches were considered by the TAF to attain the desired capability. One was to develop a Statement of Need (SON) that would be all-encompassing and would address modernization in terms of the total system. The second approach was to use an already validated requirement for a FACP replacement system (ROC 8-75A) as the basis for the modernization effort and follow it up with additional SON's

to complete the process. The ROC 8-75A approach was chosen because it could be used to quickly initiate the modernization process. This ROC, plus the development of TAF SON 316-80, for an improved surveillance and control system, would form the basis to modernize the facilities. However, ROC 8-75A was not funded for FY81. This was viewed as a major setback to modernization. To overcome this delay, the Air Staff directed a review of viable alternatives to the agreed upon TAF-preferred solution, specifically the Litton TAOC-85 being developed for the U. S. Marine Corps.

USAF CANDIDATE - MODULAR CONTROL EQUIPMENT (MCE)

In late 1979, the USAF requested formal monitoring of the U. S. Marine Corps program. In July 1980, the Air Force completed a study to determine if TAOC-85 was the best approach to satisfy USAF requirements. The results of this study were favorable and in May 1981, TAOC-85 was selected as the USAF candidate. Litton Industries was then tasked to define necessary system design changes for a USAF MCE. The U. S. Marine Corps contract was modified in July 1982 to include a USAF MCE effort.[1]

The MCE would provide commonality of equipment for the ground TACS by replacing the operational facilities of the CRC, CRP, MPC, and FACP.

The basic MCE system element is the Operations Module (OM). A single OM, housed in a standard 20 foot shelter, contains all mission essential equipment with the exception of search radar, Identification Friend or Foe (IFF), and prime power equipments. Full system functional capability is provided by a single shelter which weighs approximately 15,000 pounds with all OM equipment, including cables and antennas, installed for transport.[2]

Tailoring the MCE to a particular requirement is achieved through the use of one or more Operational Modules. Depending on the tactical situations, any combination of one to five Operations Modules may be interconnected. This connectivity is accomplished through the use of fiber optic cables. Interconnecting cables of 500 meter lengths would allow the dispersion of Operation Modules for tactical considerations or because of terrain constraints.[3]

Each Operations Module includes a functional CRC and MPC capability. A single Operations Module provides distributed data processing, operator displays, organic UHF, VHF, and HF radios for ground/air voice, TADIL A, TADIL B, LINK-1 (Allied command and control connectivity), and teletype. External connectivity includes: ground/air radios, AN/TRC-97 interconnects, TRI-TAC switch interconnectivity and fiber optic, and radio radar interfaces. Table 4 is a listing of MCE capabilities.[4]

MODULES	1	2	3	4	5
CONSOLES	4	8	12	16	20
DATA LINKS					
TADIL A	1	2	2	2	2
TADIL B/LINK-1	11	22	25	25	25
VOICE COMMUNICATIONS: ON-BOARD					
RADIO					
UHF	4	8	12	16	20
VHF	3	6	9	12	15
HF	2	4	6	8	10
TELEPHONE					
TOUCH TONE	4	8	12	16	20
DIRECT ACCESS	4	8	12	16	20
DIGITAL	1	2	3	4	5
VOICE COMMUNICATIONS: EXTERNAL	12	24	36	48	60
RADAR LINKS					
RADIO	2	4	5	5	5
FIBER OPTICS	3	5	5	5	5

MCE CAPABILITIES

TABLE 4

GROUND ATTACK CONTROL CENTER (GACC) CONCEPT

The Air Force is tasked to provide Close Air Support (CAS), Battlefield Air Interdiction (BAI), and Air Interdiction (AI) support to the Army commander.[5] However, the Air Force is limited in executing this tasking by the inability to see and detect ground targets and the inability to control and execute the missions. To correct these limitations, the TAF developed aStatement of Operational Need (SON) for a Ground Attack Control Center (GACC) capability.

The GACC concept describes the need for an operatons control function and capability dedicated to controlling attacks against time-sensitive ground targets. The GACC concept is based on the theater air defense control structure of the TACS. Specifically, the concept would decentralize the execution of air attacks against designated time-sensitive ground targets to a ground attack control function modeled on the Control and Reporting Center (CRC). The CRC mission is to attack time-sensitive air threats, and GACC would fill a current void by a similar mission of attacking time-sensitive ground threats. Like the CRC, the GACC would be a decentralized control level agency and receive its guidance and taskings from the command level structure through the Tactical Air Control Center (TACC).

The GACC concept would utilize new sensor data from three surveillance and control systems: Advanced Synthetic Aperture Radar Systems (ASARS), Precision Location and Strike System (PLSS), and Joint Surveillance and Target Attack Radar System (JOINT STARS). The ASARS and PLSS systems would use the TR-1 reconnaissance aircraft as their platform. ASARS would provide near-real-time imagery information on the location of stationary time-sensitive ground targets while PLSS would provide the location of ground emitters. JOINT-STARS is a joint Army/Air Force program designed to detect and attack moving and stationary ground targets. GACC would combine inputs from each of these elements and integrate the information with a selected air picture.

The second function of GACC deals with the "iron on target" portion of the GACC concept. This aspect of GACC would utilize fighter aircraft that will constitute the majority of the Air Force total force in the foreseeable future. This will involve aircraft using only on-board systems to navigate to and attack ground targets. The GACC would provide vectoring and precise target cueing for these aircraft.

The overall GACC can best be illustrated by using a hypothetical scenario. Let's assume an enemy ground emitter is located by PLSS. Data is passed to the ground processing station and then to the GACC. The decision is made to

divert an airborne fighter armed with a PLSS-equipped guided bomb. The divert order is passed through the CRC to the fighter and the CRC provides vectors to the point where the GACC provides final control using the PLSS mechanism. Upon reaching the launch point, the pilot releases the weapon and it receives terminal guidance to the target through the PLSS airborne platform. The GACC could perform many permutations and combinations of this example.

New sensors will provide the needed accurate and timely information on ground targets. The GACC would make it possible to respond quickly and attack enemy targets located, for the most part, in the enemy rear area. The GACC would integrate real-time sensor information with other elements of the command and control structure. This totally integrated air/ground network would locate targets, match weapons to targets according to guidance and priorities, scramble or divert allocated aircraft, and control aircraft directly to the target.

An opportunity for developing a GACC capability resulted from the similarity between the GACC process and the CRC process. This similarity makes it desirable to integrate or collocate a GACC function with a CRC function. When the U. S. Marine Corps contract with Litton Industries was modified in 1982 to include an U. S. Air Force MCE effort, GACC research and development was included in the project effort. GACC research and development efforts now

indicate that a GACC capability can be produced using MCE as the hardware baseline.[6]

COMPARISON OF CAPABILITIES: GROUND TACS VERSUS MCE

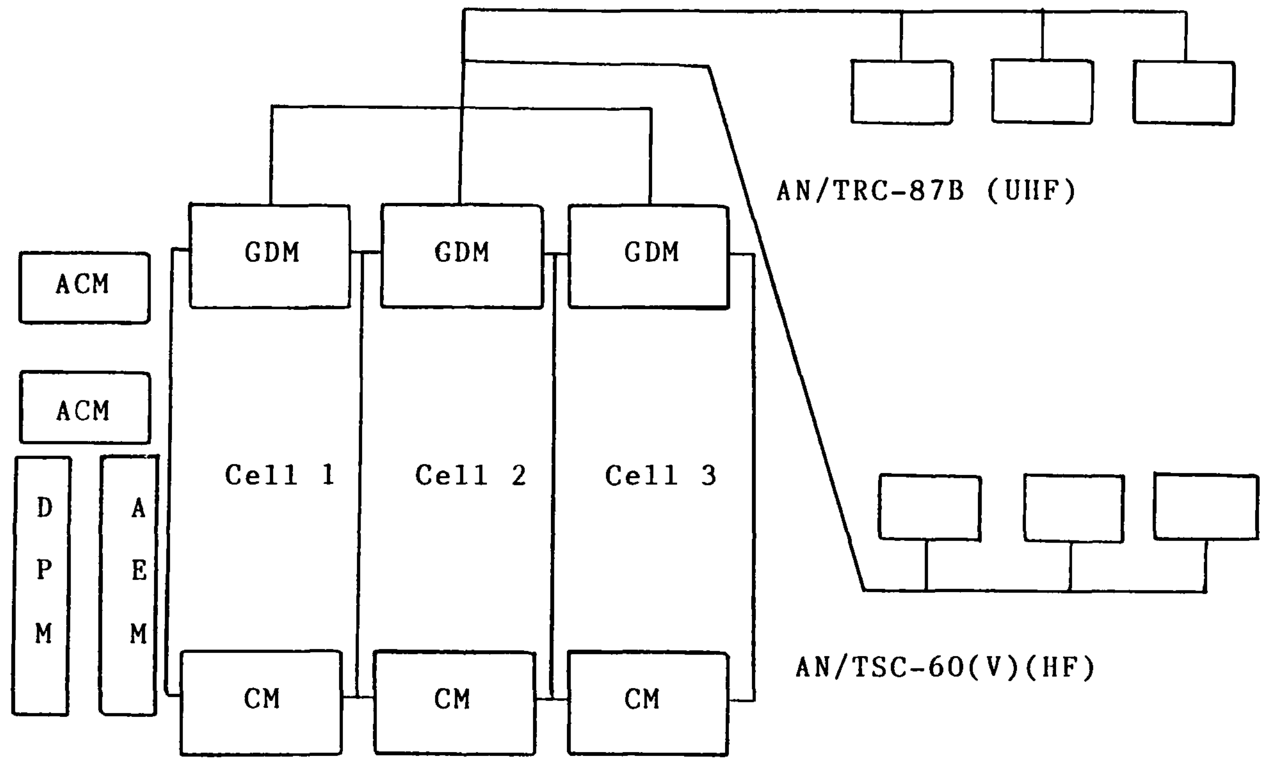
A comparative analysis of capabilities was conducted to determine the similarities and differences between the ground TACS equipment and Modular Control Equipment (MCE). This comparison will lead to conclusions concerning MCE's capability to improve command and control provided by the TACS. A hypothetical TACS contingency operation provided the basis for the comparison. The contingency operation consists of a maximum configuration Control and Reporting Center (CRC), a Forward Air Control Post (FACP), and a Message Processing Center (MPC) collocated with the CRC.

Standard doctrinal principles were applied when considering the configuration for the contingency operation. The CRC would serve as the central point for track surveillance information display and control of air assets. The FACP would be responsible for an assigned surveillance subsector and provide radar coverage in its assigned area. The FACP operation would be accomplished by voice communication of data to the CRC. The CRC would receive the majority of its information from the MPC. The MPC would be the only element capable of linking the different tactical systems in the region together. The MPC would be

responsible for the automated exchange and management of tactical data between elements of the USAF TACS, including the E-3A, and Joint Service and Allied command and control systems.

The ground TACS and MCE comparison will consider only communications and support equipment specifically required by one system but not required for the other. If the equipment would be used by both systems, it will not be included in the comparison. Equipment required by both systems and excluded from this comparison include: AN/TPS-43E, AN/TSC-62, AN/TRC-97, AN/TTC-30, and AN/TGC-28. All airlift requirement comparisons will also exclude equipment items common to both systems.

Within these guidelines, the maximum CRC operation would consist of sixteen major equipment shelters and equipment. The sixteen items would be: one Data Processing Module (DPM), one Ancillary Equipment Module (AEM), three Console Modules (CM), three Group Display Modules (GDM), two Air Conditioning Modules (ACM's), three AN/TRC-87 Radio Sets, and three AN/TSC-60 Communications Centrals. Table 5 depicts this configuration. As depicted in Table 1, the CRC in the standard AN/TSQ-91 configuration requires these modules to provide a semi-automated weapons control, surveillance and battle management function. This configuration consists of fourteen scopes and provides a TADIL B data link capability. In addition, six vans/modules

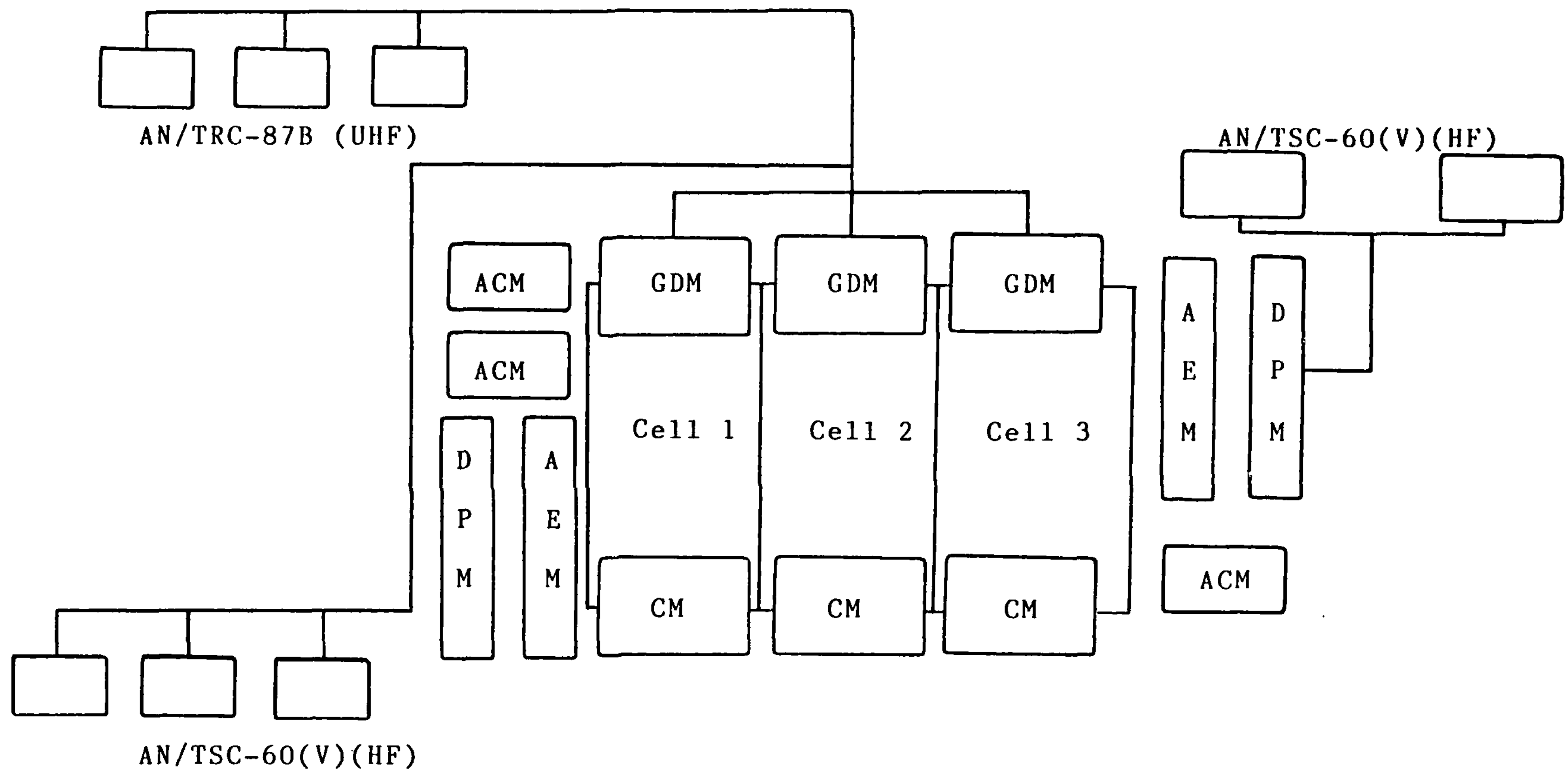


CRC/CRP CONFIGURATION

TABLE 5

are required to provide the communications necessary to fully operate the AN/TSQ-91. Three AN/TRC-87B Radio Sets are required to give the CRC sufficient ground-to-air radios to perform the weapons control function. These three radio sets provide a total of fifteen UHF radios -- five radios in each van. Three AN/TSC-60 Operation Centrals are required to provide an HF/SSB capability. These three vans provide two 2.5 KW radio transmitter/receivers in each van for voice, continuous wave (CW), teletype or high speed data, multiplexed teletype, and speech-plus-teletype signals. Approximately fifteen C-141B aircraft would be required to airlift these sixteen equipment items.

A Message Processing Center (MPC) would be required if the USAF 3-EA Airborne Warning and Control System (AWACS), or Joint/Allied command and control elements were deployed in the area of operation. The MPC would be required to provide technical and tactical interoperability between the ground TACS and other command and control elements in the region. The MPC would require five major equipment shelters: one Data Processing Module (DPM), one Ancillary Equipment Module (AEM), one Air Conditioning Module (ACM), and two AN/TSC-60 Communication Centrals for TADIL A and interface voice coordination. This three module and two communications van configuration comprises the AN/TYC-10 Message Processing Center. Table 6 depicts the combined CRC and MPC configuration.



CRC/CRP WITH MPC CONFIGURATION

TABLE 6

The CRC Operations Central (AN/TSQ-91), communications vans, and the MPC (AN/TYC-10) required for digital data link interface external to the ground TACS totals thirteen modules and eight vans. This configuration provides fourteen operator console positions in the CRC and two positions in the MPC. The situation display in the MPC is different from the display in the CRC. As discussed in Chapter III, the MPC employs the Interface Message Processing Program (IMPP) to perform the message translation, display, and message generation function. The IMPP provides the capability to receive, store, and display more surveillance track reports in a larger area; however, there is no radar in the MPC. The MPC must receive all surveillance track data from other units and cannot originate a surveillance track. When the CRC and MPC are collocated, there are a total of eleven data links available for external operations -- ten TADIL B and one TADIL A. The twenty-one equipment shelters in this combined configuration would require approximately eighteen C-141B aircraft to deploy the system.

To provide the most accurate comparison between the ground TACS equipment and MCE in this contingency operation, four Operations Modules were used as the MCE configuration baseline. Four Operations Modules were selected because this configuration would contain sixteen operator console

units capable of displaying the real-time air situation. This is a two console increase over the CRC and MPC configuration. This configuration would include enough operator positions to perform the functions of weapons control, surveillance, battle management, and interface management.

Differences become apparent when this common baseline is established. A single Operations Module contains all mission essential equipment with the exception of radar and power requirements. This includes core data processing and on-board communications. Each Operations Module includes a functional MPC capability with a multiple data link capability for the exchange and management of technical and tactical data. This data link capability would totally eliminate the requirement for an MPC. Each Operations Module would provide four UHF, three VHF, and two HF radios for voice and data communications. This on-board Operations Module capbility would eliminate the three AN/TRC-87 Radio Sets and five AN/TSC-60 Communication Centrals required with the CRC and MPC. The exact track capability and operator display area are classified; however, both exceed the capability of the CRC and MPC. Four C-141B aircraft would be required to deploy the four Operations Modules. Table 7 provides a detailed comparison of the maximum CRC with a collocated MPC and the MCE. This comparison does not take into consideration the added deployment and employment

COMPARISON STANDARDS	CRC/MPC	MCE
OPERATOR POSITIONS	16	16
SHELTERS	21	4
DATA LINKS	11	27
RADIO COMMUNICATIONS	21	36
C-141B REQUIREMENT	18	4

CRC/MPC AND MCE COMPARISON

TABLE 7

flexibility gained with MCE. This enhancement will be discussed in greater detail in Chapter V.

In this hypothetical TACS contingency operation, a Forward Air Control Post (FACP) has been deployed in the forward area of the battle zone to provide increased low-level radar coverage of air operations. This is realistic and consistent with the FACP deployment and employment doctrine discussed earlier. It is difficult to compare the FACP with MCE because they differ significantly in terms of capabilities. However, for this analysis, a two Operations Module configuration will be used to highlight the difference in capabilities.

The FACP in the standard configuration would require two modules/vans: one AN/TSQ-61 Operations Central and one AN/TSC-53 Communications Central. This configuration provides two operator positions for weapons control and surveillance. The FACP is a totally manual system and all information must be voice communicated to the semi-automated g.ound TACS system. This is a very time-consuming process, and the task is made even harder in a communications jamming environment. A total of six radios are available in this configuration: two UHF, two VHF, and two HF. Five C-141B's would be required to deploy the entire FACP; however, for the purpose of this analysis, equipment common to both systems has been excluded. Therefore, two C-141B aircraft would be required to deploy the two vans.

When MCE is used to replace the FACP function, two Operations Modules would provide a significantly increased capability. The two Operations Modules would provide eight operator consoles. In addition, a totally automated air surveillance, weapons control, battle/airspace management, and interface management capability would be achieved in the forward area. Each MCE-equipped FACP would have the Message Processing Center digital data interface capability to fully interoperate with other ground TACS elements and the E-3A. Additionally, the MCE-equipped FACP would be capable of netting information with Allied and U. S. Service command and control systems. This capability to present a composite air picture in an entire area of operations would enable the Air Force to better perform the responsibilities of the Area Air Defense Commander and Airspace Control Authority. This capability is a significant improvement over the current TACS command and control structure capability. Table 8 provides a comparison of the two systems. As mentioned previously, MCE has added flexibility not available in the FACP. The MCE has the capability to receive radar plot data from a remote radar set; therefore, the forward deployed AN/TSQ-61 Operations Central and AN/TSC-53 Communications Central could be eliminated. A forward deployed remote AN/TPS-43E radar set could receive and transmit data automatically to the MCE in the rear area via an AN/TRC-97 troposcatter radio set. Employing this technique would

COMPARISON STANDARDS	FACP	MCE
OPERATOR POSITIONS	2	8
SHELTERS	2	2
DATA LINKS	MANUAL (NONE)	24
RADIO COMMUNICATIONS	6	18
C-141B REQUIREMENT	2	2

FACP AND MCE COMPARISON

TABLE 8

require only a forward deployed radar set and troposcatter radio set. Chapter V will discuss the inherent flexibility of MCE in greater detail.

MCE provides one additional capbility that cannot be equated to a present-day TACS capability. The TAF has developed a Statement of Operational Need (SON) for a Ground Attack Control Center (GACC) capability. New sensors being developed and introduced into the Air Force inventory will provide accurate and timely information on ground targets. The GACC would make it possible to respond quickly and attack enemy ground targets located, for the most part, in the enemy rear area. This totally new GACC capability can be produced using MCE as the hardware baseline.

SUMMARY

The Modular Control Equipment (MCE) envisioned to replace current TACS equipment consists of two key capabilities to improve the ground surveillance and control elements. First, MCE will replace the operational facilities of the Control and Reporting Center (CRC), the Control and Reporting Post (CRP), the Message Processing Center (MPC), and the Forward Air Control Post. The modular approach provides the capability for TADIL A and TADIL B data link interoperability in each Operations Module. This provides an automated capability down to the FACP level.

Second, MCE provides the hardware baseline for the Ground Attack Control Center (GACC). This new operational capability will permit display of time-sensitive ground targets (tank/troop concentrations, threat emitters, high value point targets) in the enemy second echelon. GACC will receive and display ground targets based on sensor data from Joint Surveillance and Target Attack Radar System (JOINT STARS), Precision Location and Strike System (PLSS), and Advanced Synthetic Aperture Radar System (ASARS). This GACC concept would decentralize the execution of air attacks against designated time-sensitive ground targets to a ground attack control function modeled on the Control and Reporting Center.

ENDNOTES

1. Modular Control Equipment, Litton Data Systems: p. 59.

2. Ibid., p. 11.

3. Ibid., p. 7.

4. Ibid., p. 17.

5. U. S. Air Force, TACR 55-45, Tactical Air Force Headquarters and Tactical Air Control Center -- Operations (1984): p. 5-3.

6. Interview and telephone conversation with Litton Data System personnel, February 1985.

CHAPTER V

FORCE INTEGRATION OF MCE INTO THE TACS STRUCTURE

The introduction of Modular Control Equipment (MCE) into the Tactical Air Control System (TACS) inventory will require a reassessment of current deployment and employment strategy. MCE is a new system which provides increased flexibility and improved capabilities; however, the TACS will not realize all the enhancements unless a systematic force integration approach is undertaken.

> Force integration is the introduction, incorporation, and sustainment of doctrine, new organizations, and new equipment into an extant force structure. It must be understood that this is a multidimensional affair that affects every level of an organization.[1]

MCE force integration will present problems as the new system is introduced into an existing structure. Many of the problems will be generated by the changes that will accompany the integration.

MCE will utilize a completely new family of equipment; therefore, change will impact every level of the TACS structure. Several characteristics, common to any large-scale change, will be recognizable as MCE is introduced into the structure. Characteristics of the states of change are summarized in Table 9.[2]

	Present State	Transition State	Future State
Procedures	Has known/familiar procedures, methods of operation that are finely tuned, almost habits.	Procedures and methods of operation are not well known and may be new or unpredictable.	Has totally unknown/unfamiliar procedures and methods, new methods will have to be created.
Operating Environment	Largely predictable. Leaders can anticipate.	One of rapid and diverse changes. It will be unpredictable. This will not allow for a great deal of anticipation.	Mostly unpredictable creating a leadership problem.
Work Requirements	Job description and work are well specified and understood.	Changing jobs, tasks, and demands which may seem to change daily.	There will be tasks and demands that may or may not be anticipated.
Unit Atmosphere	Has a sense of stability and permanence.	Has a sense of instability.	Mostly unknown/unpredictable.

Characteristics of the States of Change

TABLE 9

As MCE is fielded and moves through each stage, the change should be managed and not just allowed to happen. Resistance is sometimes the initial response when humans are confronted with change; therefore, change management should take into consideration the human dimension. This human dimension should be considered early in the transition process. Education and training will be required to ensure a complete change in philosophy and attitudes. This education and training process will be the carrier wave for incorporating and sustaining doctrine.

Doctrine should remain the touchstone for the utilization of men, equipment, and tactics during the transition states from initial force modernization to total force integration.[3] Doctrine should trigger everything -- planning, tactics, and strategy. Doctrine for the TACS is prescribed in Air Force Manual 2-7 and provides the basic framework for command and control of Tactical Air Forces. Any deployment or employment concept stemming from this broad doctrinal guidance should be directly linked to current wartime requirements and be consistent with the TACS worldwide contingency commitment. This means being able to satisfy a broad mission statement using doctrine that is current and capable of achieving objectives in support of national policy. The end result is a command and control structure that is simple, and consistent with the philosophy of centralized control and decentralized execution.

As discussed in Chapter I, doctrine has sometimes lagged behind our technological advances. Therefore, for a weapons system to have utility, it must provide the capability to execute current doctrine and have the capability to counter the present threat. MCE possesses these capabilities and provides improved capabilities over today's ground TACS system. The Air Force should ensure that the present doctrine remains current and aligned to the system's technological capability. Only by satisfying both objectives will the TACS be capable of meeting command and control challenges.

MCE force integration should not stop with fielding a technologically superior system and aligning doctrine to the technological capability. There must also be a change in thinking concerning MCE deployment and employment strategy. Today's ground TACS deployment and employment thinking should not provide the model around which new concepts are developed. MCE should be recognized as an improved generation of equipment requiring new and improved methods of deployment and employment. The next section will suggest some necessary changes in ground surveillance and control deployment and employment strategy brought about by MCE.

DEPLOYMENT AND EMPLOYMENT STRATEGY

MCE will provide increased operational capabilities and flexibility. Certain changes in the ground surveillance and control deployment and employment strategy are therefore appropriate and necessary. As discussed in Chapter III, the current ground TACS elements equate type of equipment to function. The AN/TSQ-91 is a Control and Reporting Center (CRC) or Control and Reporting Post (CRP). The AN/TSQ-61 is a Forward Air Control Post (FACP), and the AN/TYC-10 is a Message Processing Center (MPC). This type of equipment-function relationship also applies to the command and control structure and information reporting hierarchy. The TACS structure of FACP's reporting to CRP's which in turn report to the CRC was designed primarily to provide adequate span of control of the manual FACP radar elements.

With MCE, the employment capabilities will differ significantly from today's system. The improvements are such that the old concepts no longer apply. Two significant differences involve the CRP and MPC equipment and function. The CRP possesses capabilities similar to the CRC and may assume CRC functions when required. The CRP also functions as an information filter and relay element connecting the automated CRC with the manual FACP. The MPC provides the TADIL A connectivity with the USAF E-3A Airborne Warning and Control System (AWACS), the two Navy systems (NTDS and

ATDS), and the U. S. Marine Corps' TADIL A elements. The MPC also is capable of technical and tactical management of data received from interfacing units. MCE adds a new dimension to the TACS structure. Each MCE Operations Module includes a functional CRC and MPC capability. The specific requirement for CRP and MPC type equipment and functions are no longer required.

This change in TACS thinking implies some changes for the future ground TACS surveillance and control elements. The inherent Operations Module commonality available with MCE creates a requirement for only two facilities as we know them today -- the CRC and FACP. Taking this concept a step further, the future TACS structure will require only forward deployed and rear area deployed surveillance and control elements. Tailoring the size of these generic elements must consider sensor coverage, required elements for interface with other command and control elements, and the necessary communications to provide a viable control system. Tailoring must also consider the size and topography of the area of operation, types of operations planned, the threat, and desired system redundancy.[4] Use of a generic structure that utilizes forward and rear deployed elements would allow the elements to be sized based on the required function. This flexibility permits tailoring to large or small scale operations. In addition, consideration should be given to the essential command and control functions of

battle/airspace management, air surveillance/identification, interface management, and weapons control.[5]

Tailoring the MCE to a particular requirement is achieved through the use of one or more Operations Modules. Each Operations Module has a full system functional capability, and additional Operations Modules can be added depending on the tactical situation. Using this approach, the ground TACS capability desired would be expressed in terms of the number of MCE Operations Modules required to perform the essential command and control functions in the forward and rear area. The name assigned the elements that perform these essential functions will not be extremely important. However, the terms selected should probably consider the geographic location of the facility on the battlefield and the function performed in relation to the tactical location. Two terms could be used to connote the facility's mission when using this criteria. The Control and Reporting Center would be termed a Rear Area Control Center (RACC). Using the same geographic and functional philosophy, the Forward Air Control Post would be called a Forward Air Control Center (FACC).

The Rear Area Control Center (RACC) would be formed by interconnecting four Operations Modules with fiber optic cable. The RACC would include capabilities for battle/airspace management, air surveillance/identification, interface management, and weapons control. This four

Operations Module configuration would enable the RACC to control all tactical air operations in the area of operation. In addition, it would provide a capability to interface and centrally manage the technical and tactical data received from Joint and Allied service systems. This integration would enable the Tactical Air Forces (TAF) Commander to provide centralized control of all Tactical Air Forces assigned or attached.

A four Operations Module RACC would contain sixteen operator console units capable of displaying the real-time situation. This configuration would provide two more consoles than the existing 407L CRC. Sixteen scopes are available when an MPC is collocated with the CRC. Since the RACC has a CRC and MPC capability, the CRC and MPC comparison is the most appropriate. The sixteen consoles could be divided by function to perform the following tasks: four for battle/airspace management, four for air surveillance/identification, two for interface management, and six for weapons control. This is only a recommended assignment and an increase or decrease in a functional area would be scenario dependent.

The Forward Air Control Center (FACC) would be employed in the forward area. Each FACC would consist of two Operations Modules. The functions of a FACC would be to provide air surveillance and early warning, weapons control, and battle and airspace management in the forward area.

Each FACC would have the MPC interface capability to fully interoperate with other ground TACS elements and the E-3A. Additionally, as with the RACC, each FACC would be capable of interfacing with the U. S. Army AN/TSQ-73 Air Defense Command and Control System (AADCCS), the U. S. Navy and Airborne Tactical Data Systems (NTDS/ATDS), the U. S. Marine Corps Air Command and Control Systems (MACCS), and Allied command and control systems.

A two Operations Module Forward Air Control Center would provide eight operator console positions. This is an increase of four consoles over the existing FACP. Today's FACP has a four console capability -- two in the AN/TSQ-61 and two in the AN/TPS-43 radar van. This one hundred percent increase in display capability may initially seem excessive. The capability is justified because the extra consoles and communications would enable the Air Force to take advantage of operational capabilities and interoperability never before associated with a manual FACP. The eight consoles could be divided by function to perform the following tasks: four for weapons control, two for air surveillance and early warning, one for battle and airspace management, and one for interface management. The number of Forward Air Control Centers required would depend on the tailoring factors previously discussed.

One significant capability derived from MCE is totally unrelated to the replacement of operations

facilities of the existing command and control structure. MCE would be the hardware baseline for a new command and control facility -- the Ground Attack Control Center (GACC). The GACC mission would be to provide a control capability for air attacks against time-sensitive ground targets. Three MCE Operations Modules could provide the necessary operator console units and communications to support the Ground Attack Control Center function of battle/interface management, surveillance, and attack control. One example of how the Operations Module functional assignment might be organized is as follows: one Operations Module (four consoles) for overall battle management, one Operations Module (four consoles) to coordinate and deconflict the air and ground picture and provide sensor management, and one Operations Module (four consoles) to support the attack control function.

MCE is the primary candidate to replace the aging equipment being used in the TACS. MCE, however, provides more than a one-for-one replacement value over the current system. With innovative and imaginative thinking, MCE could provide a system for the Tactical Air Forces (TAF) Commander that is a true force multiplier.

DOCTRINAL ISSUES

"Air Force Manual 2-7 establishes the operational doctrine for directing, coordinating, and controlling Tactical Air Forces in combat and the employment of a TACS in support of tactical air operations."[6] This manual is written in very broad terms and addresses command and control principles and functions. The doctrine provides general guidance. This guidance gives the TACS latitude to function within the framework of centralized control and decentralized execution.

The historical evolution of the TACS has been a slow process accompanied by strong resistance to any change. The essential command and control functions have also evolved over time and should remain valid for the foreseeable future. MCE will provide the technology to perform the essential command and control functions and be an effective weapons system against current threats. However, the MCE modernization effort should not be viewed as a revolutionary step. The doctrinal concepts used today will be valid with MCE. The difference is that MCE will provide the technological capabilities to execute current doctrine. This execution capability is in jeopardy with the current ground TACS elements. No functions have been changed with MCE, they are only repackaged to focus attention on correcting problems with mobility, survivability, and

equipment obsolescence. In addition, MCE takes advantage of the near-term opportunity to build a Ground Attack Control Center capability. Specifically, this comes from the very great similarity between the ground attack control process (an air control process) and the air control process as practiced by the air control elements.

Doctrine for the TACS structure will not change with the force integration of MCE. Current doctrine is valid and should provide the foundation for developing new strategy and tactics. This does not mean that with MCE everything will remain the same. MCE integration will require many changes. These changes will be necessary to take advantage of flexibility not available with the current TACS. MCE can be tied into multiple radars/systems; it can be remoted from the radar; it can be deployed autonomously and work directly with the E-3A; and it can move quickly to a new location without degrading the on-going mission.[7] These improvements will generate the requirement for changes in several areas. The overall TACS deployment configuration on the battlefield will have to be changed. Procedures will have to be totally revised. A coordination process will have to be developed to accomodate the change from operating in a single facility to an environment where several functionally separated facilities are employed. The requirement to operate in separate functional areas will change the operator's work environment. Finally, all of these changes will impact on

the human dimension and unit atmosphere. These changes will have to be recognized and managed to fully exploit the enhancements of the system.

FORCE STRUCTURE ISSUES

A force structure realignment will be part of MCE force integration. The TACS is currently below the 1984 directed Time Phased Force Development Listing (TPFDL) wartime requirement. There is no plan to increase the TACS unit force structure above current levels. It is important to note that FY87-94 USAF tactical command and control planning projects an even greater increase in the required number of ground TACS units.[8] Table 10 lists the approximate number of units that will be in the TACS force structure in 1988. The table also depicts the number of Operations Modules required to replace these ground TACS units on a unit-by-unit replacement basis. This MCE replacement process provides a greater overall capability to accomplish the essential command and control functions. This increased capability is significant because the TACS is projected to remain below its directed TPFDL wartime requirement.

ELEMENT	NUMBER	x	OPERATIONS MODULES	=	TOTAL
CRC/CRP	15		4		60
FACP	31		2		62

MCE REPLACEMENT MODULES

TABLE 10

Not reflected in Table 10 is the requirement for approximately eight Ground Attack Control Centers. These eight GACC's, configured with three Operations Modules each, would generate a requirement for twenty-four Operations Modules. This twenty-four Operations Module capability, plus the 122 required to replace the CRC/CRP's and FACP's, brings the total to 146. In addition, one Operations Module could be collocated with each Tactical Air Control Center (TACC) to provide a real-time air situations display to the TACS command element. Using this logic, 149 Operations Modules would satisfy the 1988 force requirement.

SUMMARY

Modular Control Equipment (MCE) will utilize a completely new family of equipment; therefore, change will accompany its integration into the TACS structure. As MCE force integration occurs, it must be managed and guided by innovative and imaginative thinking. Current doctrinal concepts will be valid with MCE and should provide the framework for managing the force integration effort. MCE's improved technological capability will correct the deficiencies associated with the current system. These improvements will require a change in thinking concerning TACS deployment and employment strategy. In addition, new tactics and procedures must be developed, and the overall

force structure must be realigned. These changes are necessary to take advantage of the increased flexibility resulting from the Operations Module commonality. This standardized facility permits tailoring MCE to a particular requirement. Using this approach, the ground TACS capability desired would be expressed in terms of the number of Operations Modules required to perform the essential command and control functions.

MCE should be recognized as a new generation of equipment with the capability to execute current doctrine and counter the present threat. The force integration effort must capitalize on these features to ensure a system for the TAF Commander that is a true force multiplier.

ENDNOTES

1. Le Cuyer, Jack A., Lieutenant Colonel. "Force Integration," Military Review, (February, 1984): 18.

2. U. S. Army, Reference Book 26-16, Commander's Guide to Force Integration. (August, 1983): 11.

3. U. S. Air Force, AFM 1-1, Basic Aerospace Doctrine of the United States Air Force, (1984): Introductory Comment.

4. U. S. Air Force, TACR 55-44, Tactical Air Control System (TACS) Surveillance and Control of Tactical Air Operations. (1975): 5.

5. U. S. Air Force, AFM 2-7, Tactical Air Force Operations - Tactical Air Control System (TACS). (1979): 2-2.

6. Ibid., p i.

7. Interview and telephone conversation with Litton Data system personnel, March 1985.

8. Interview and telephone conversation with HQTAC Directorate of Command and Control (DOY) personnel, March 1985.

CHAPTER VI

CONCLUSIONS, RECOMMENDATIONS FOR FUTURE STUDY, AND SUMMARY

CONCLUSIONS

The ground sureillance and control equipment in the TACS is deficient and no longer provides the deployment and employment capabilities required by the Tactical Air Forces (TAF) Commander. These deficiencies center on four key areas: mobility, survivability, obsolescence, and the limited data link interface capability with U. S. Tactical Air Forces and Allied command and control systems. The mobility problems involve the time involved to deploy/setup the CRC/CRP. Associated with this is the equipment deterioration experienced with each deployment. In addition to deteriorating equipment, the inflatable shelters have many drawbacks. They are heavy, bulky, and susceptible to environmental damage. When prepared for deployment, they require a prohibitive quantity of airlift. The survivability is dubious in combat because of the size of the facilities and the Infrared (IR) signature. Obsolescence is a problem because software changes to meet new requirements will require replacement of processors and input devices and recoding to meet expanding needs. Finally, lack of automation at the Forward Air Control Post impacts on information flow throughout the TACS structure.

It denies real-time dissemination of situation data and prohibits a real-time composite situation display. In addition, the Air Force TADIL A interface depends on the MPC, and there are only eight of these facilities.

Modular Control Equipment (MCE) envisioned to replace current TACS equipment will eliminate these problems and improve command and control provided by the TACS. The thesis hypothesis was proven by comparing the capabilities of the present-day ground surveillance and control elements of the Tactical Air Control System (TACS) with the MCE envisioned to replace the current system. The TACS mission directive was used as the baseline to conduct the analysis. The TACS must provide the Tactical Air Forces (TAF) Commander with the capability to direct and control tactical air assets. "Capability" translates into being able to respond to contingencies on a worldwide basis. Once deployed in a theater, the system must then be able to carry out its assigned mission.

To accomplish the TACS mission requires having a system that optimizes the operator/command and control function employment mix, and utilizes technology that is capable of achieving objectives against current threats. However, this capability is of no value unless the system is small enough to be deployable, and flexible enough to allow tailoring to meet the contingency requirement. In

validating the thesis hypothesis, the comparative analysis focused on which system best satisfied these requirements.

MCE would replace the operations facilities of the Control and Reporting Center (CRC), the Control and Reporting Post (CRP), the Message Processing Center (MPC), and the Forward Air Control Post. The modular approach would provide the capability for TADIL A and TADIL B data link interoperability in each Operations Module. This capability would provide an automated capability down to the FACP level -- something never before available in the TACS. In addition, the number of shelters required would be significantly reduced with a corresponding reduction in airlift. The contingency deployment of the maximum CRC, MPC, and FACP, previously discussed, would require twenty C-141B aircraft to airlift twenty-three major equipment shelters. If MCE were deployed, only six C-141B aircraft would be required to airlift six major MCE shelters. With this reduction of fourteen aircraft there would be an overall increase i digital data link and radio communications capability. All of this would be achieved using on-board radios, antennas and cables self-contained for transport.

A single Operations Module would provide the core command and control configuration. The modular approach would provide greater flexibility and reduce the deployment/setup time required with the current system.

Depending on the tactical situation, additional capability would be achieved by interconnecting Operations Modules as required (maximum of five) using fiber optic cable. The Operations Module systems would then be deployed and configured on the battlefield in response to the threat. The netting of each Operations Module system via digital data link would provide the TACS structure with a composite battle situation display for the first time ever. Four operator positions would be available in each Operations Module, and the four Operations Module configuration would provide an increase of two operator positions over the current CRC. A four Operations Module system would provide the capability to perform all the essential theater command and control functions.

Finally, with MCE the TAF would acquire the capability to perform the Ground Attack Control Center (GACC) mission. This totally new capability is extremely important because of the importance being placed on an Air Force capability to execute AirLand battle doctrine. Using MCE as the hardware baseline, the Air Force would be able to field a system to provide the control capability for executing attacks against time-sensitive ground targets. The GACC would receive a ground situation display from new airborne sensors and a selected air picture from the existing TACS structure. Using the existing structure and doctrine, the Air Force would employ the GACC capability and

introduce a new and vitally needed capability on the AirLand battlefield.

RECOMMENDATIONS FOR FUTURE STUDY

This study focused on the current and future effectiveness of Modular Control Equipment in the Tactical Air Control System. Although MCE would provide additional flexibility and capability, other improvements are needed. Further study should be undertaken to determine how to increase the survivability and effectiveness of existing radar sensors. If this is deemed impossible or impracticable, a study might address what capabilities the TACS radar sensor of the future should possess.

Communications is another area of concern for the TACS. A study should be undertaken to determine how to best protect and secure vital ground-to-air voice links. In addition, a study might explore how to improve point-to-point voice and data links and improve and protect the ground-to-air digital data links.

Managing, distributing, and displaying information has been a problem for many years. With MCE, all elements of the TACS will be completely automated except the senior element -- the Tactical Air Control Center. A study should be undertaken to assess what impact this will have on command and control.

Finally, a manpower realignment will be required when MCE is fielded. A study should be undertaken to determine what operator skills will be required to man the system. In addition, a study should be undertaken to determine what the actual authorized manning level by Air Force Speciality Code (AFSC) should be for each of the functional MCE elements.

SUMMARY

Modular Control Equipment will significantly improve command and control provided by the TACS. The enhancements realized through this program make it the obvious choice for TACS modernization. The Air Force should aggressively pursue funding for the program and implementation into the Air Force inventory at the earliest possible date.

Modular Control Equipment satisfies all of the requirements specified in USAF ROC 8-75A (Improved Forward Air Control Post) and TAF Statement of Need 316-80 (Improved Surveillance and Control System). Modular Control Equipment would replace the current ground surveillance and control operational facilities. Additionally, Modular Control Equipment would be the hardware baseline for the Ground Attack Control Center capability not currently available in the Tactical Air Control System.

This increased capability would be achieved by employment of the Operations Module, which is the basic MCE

system element. Each Operations Module is functionally and physically identical; therefore, there would be commonality of equipment throughout the ground TACS structure. Along with the standardization of equipment would come an increased data link and communications capability. In addition, the added flexibility gained by employing a standard Operations Module would provide many configuration options not available with today's system. Each Operations Module would have a functional Control and Reporting Center and Message Processing Center capability, thus eliminating the requirement for Control and Reporting Posts and Message Processing Center equipment. These Operations Modules could be deployed in the forward and rear areas and configured as necessary to counter the threat. A four Operations Module Rear Area Control Center and a two Operations Module Forward Air Control Center configuration would provide the capability to accomplish essential command and control functions. Using this force structure alignment, a total of 149 Operations Modules would replace the current ground surveillance and control elements on a unit-by-unit replacement basis. Operational and tactical doctrine used today will be valid with MCE. Changes in current strategy and tactics, however, will take advantage of MCE's increased flexibility and operational capability. These adjustments will enable the ground TACS, with MCE, to be a force multiplier on the AirLand battlefield.

BIBLIOGRAPHY

BOOKS

Brodie, Bernard. Strategy in the Missile Age. Princeton, N.J.: Princeton University Press, 1959.

Craven, Wesley Frank, and Cate, James Lea, eds. The Army Air Forces in World War II. 7 Volumes. Chicago: The University of Chicago Press, 1948-1958.

Dupuy, Trevor N., The Military History of World War II: Volume 6, The Air War in the West: September 1939 - May 1941, New York, Franklin Watts, Inc., 1963.

Dupuy, Trevor N., The Military History of World War II: Volume 7, The Air War in the West: June 1941 - April 1945, New York, Franklin Watts, Inc., 1963.

Futrell, Robert F. Ideas. Concepts. Doctrine: A History of Basic Thinking in the United States Air Force 1907-1964. Maxwell AFB, Alabama: Air University, 1974.

Goldberg, Alfred F., ed. A History of the United States Air Force, 1907-1957. Princeton, N.J.: D Van Nostrand Company, Inc., 1957.

Greenfield, Kent Roberts. American Strategy in World War II: A Reconsideration. Baltimore: The Johns Hopkins University Press, 1962.

Hackett, John. The Third World War: August 1985. New York: MacMillan Publishing Co., Inc., 1978.

Hart, Liddell B. F. Strategy. New York: Frederick A. Praeger, Inc., 1954.

Kohn, Richard H. and Harahan, Joseph P. Air Superiority in World War II and Korea. Office of Air Force History, United States Air Force, Washington, D. C., 1983

Lane, John J., Command and Control and Communications Structures in Southeast Asia. Air War College, Maxwell Air Force Base, Alabama, 1981.

Martin, James T., Telecommunications and the Computer, Englewood Cliffs, NJ, Prentice-Hill, Inc., 1976.

Momyer, William W. Airpower in Three Wars. Washington: Department of the Air Force, 1978.

Osgood, Robert E. Limited War Revisited. Boulder, Colorado, Westview Press, 1979.

Read, Thornton, Command and Control, Policy Memo #24, Center of International Affairs, Princeton University, 15 June 1961.

Taylor, General Maxwell D. The Uncertain Trumpet, New York, Harper and Brothers, 1959.

Weigley, Russell F. The American Way of War: A History of United States Military Strategy and Policy. New York: The MacMillan Company, 1973.

PERIODICALS

Michaelis, Admiral Frederick H. "The C3 Generation," Signal, Vol. 30, No. 2, October 1975, pp. 28-31.

Ulsomer, Edgar. "AWACS: USAF's Most Successful Development Program," Air Force Magazine, Vol. 57, July 1974, pp. 69-76.

MILITARY PUBLICATIONS

Tactical Air Force Operations - Tactical Air Control (TACS), AFM 2-7, Department of the Air Force, Washington, D. C., 20 February 1979.

Tactical Air Operations, TAC Manual 2-1, Headquarters Tactical Air Command, Langley AFB, VA, 15 April 1978.

Tactical Air Control System - E-3A/Ground Environment Interface Training, TAC Regulation 50-32, Headquarters Tactical Air Command, Langley AFB, VA, 29 August 1980.

Tactical Air Control System Equipment, TAC Pamphlet 55-43, Headquarters Tactical Air Command, Langley AFB, VA, 15 May 1981.

Tactical Air Control System (TACS), Surveillance and Control of Tactical Air Operations, TAC Regulation 55-44, Headquarters Tactical Air Command, Langley AFB, VA, 20 March 1975.

Tactical Air Force Headquarters and The Tactical Air Control Center, TAC Regulation 55-45, Headquarters Tactical Air Command, Langley AFB, VA, 26 October 1984.

U. S. Air Force. _Basic Aerospace Doctrine of the United States Air Force_, AFM 1-1, Department of the Air Force, Washington, D. C.: 16 March 1984.

U. S. Army. _Operations_. FM 100-5. Washington, D. C.: Department of the Army, 1982.

U. S. Army. _The Air-Ground Operations System_. FM 100-26. Washington, D. C.: Department of the Army, March 1973.

U. S. Army. _Air-Ground Operations_. FC 100-26. U. S. Army Command and General Staff College, Fort Leavenworth, Kansas, July 1984.

U. S. Army. _Army Airspace Command and Control in a Combat Zone_. FC 100-1-103. Washington, D. C.: Department of the Army, August 1984.

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